Annex A: Hazard Identification and Analysis

I. Purpose.

To identify and analyze the types of natural hazards that could threaten Cabarrus County.

II. Situations and Assumptions.

A. Cabarrus County is vulnerable to a number of natural hazards at various times. These hazards including severe thunderstorms, tornadoes, inland hurricane effects, flooding, and severe winter weather/ice storms. Each hazard is unique to Cabarrus County in terms of impact, frequency, and likelihood of occurrence.

B. The towns of Mount Pleasant, Harrisburg, and Midland are subject to the same hazards as the remainder of the county. The identification and analysis of these hazards for the county apply equally to these municipalities.

III. Concept.

A. The following sections describe and discuss the natural hazards that can effect Cabarrus County. Climatic and historic data were used to identify the potential for each of the hazards. The last section summarizes the hazards and rates each on its potential to cause a natural disaster in Cabarrus County. Tables A-8 to A-11 at the end of this section summarize data on significant past storm events that have had an impact on Cabarrus County.

B. Natural Hazards

1. Hurricanes.

(a) Hurricanes are the most devastating natural events on the east coast of the United States. Basically, a hurricane is a type of tropical cyclone, which is a low-pressure system that generally forms in the tropics. Hurricanes have a number of conditions necessary to occur. This includes a pre-existing weather disturbance, warm tropical oceans, moisture, and relatively light winds aloft. If these all come together, they can produce a hurricane which can lead to violent winds, high waves, torrential rains, storm surge, tornadoes, and floods. A typical hurricane drops 6 – 12 inches of water on the area it crosses. Tornadoes often form on the fringes of the storm. The Saffir-Simpson Hurricane Scale defines hurricane strength.

Table A-1: Saffir-Simpson Hurricane Scale

Category	Definition-Effects
1	Winds : 74-95 mph (64-82 kt) No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.
2	Winds : 96-110 mph (83-95 kt) Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.

3	Winds : 111-130 mph (96-113 kt) Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain may be flooded well inland.
4	Winds : 131-155 mph (114-135 kt) More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.
5	Winds : 155+ mph (135+ kt) Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.

(b) These storms have long threatened the North Carolina coastal plain, but Cabarrus County has occasionally felt the effects of hurricanes that have retained their force after landfall. Generally, these storms are not those that cross the North Carolina coast, but those that make landfall farther to the south. It is not unusual to receive the effects of hurricanes from as far south as the Gulf coast. Typically these storms bring heavy rains and some high winds. This can cause flooding in some areas of the county. Cabarrus County has experienced development in high-risk areas such as river and stream floodplains that are vulnerable to flooding caused by inland hurricane effects. Cabarrus County also has a number of manufactured homes that are vulnerable to flooding.

(c) According to historical data, North Carolina has experienced landfall hurricanes more frequently in recent years, each having a measurable impact on some area of the State. A major landfall hurricane can have a tremendous adverse impact on Cabarrus County in terms of property damage, loss of life, and economic impacts from business closures. Hurricane Hugo in 1989 had a serious impact on the county, and is an example of the damage possible from inland hurricane effects.

(d) Similar to hurricanes, Nor'easters are ocean storms capable of causing damage to coastal areas due to strong winds and heavy surf. Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane force winds and causing beach erosion and coastal flowing. Due to the inland nature of Cabarrus County Nor'easters are viewed primarily as winter storm type events as the coastal storm characteristics would not likely be observed in the county.

2. Floods (Map A-1 Cabarrus County Multi-Hazards)

(a). Flooding is normally the result of a larger event such as a hurricane, thunderstorm or prolonged rainfall. Flooding is caused by excessive precipitation and can be generally considered in two categories: flash floods and general floods. Flash floods are the product of localized, high-intensity precipitation over a short time period in small drainage basins. General floods are caused by precipitation over a longer time period and over a given river basin. A combination of river basin physiography, local thunderstorm movements, past soil moisture conditions, and the degree of vegetative clearing determine the severity of a flooding event. Flooding is typically most severe in areas of the floodplain immediately adjacent to major streams and rivers.

(b) Flooding can be as frequent as the occurrence of a spring rain or summer thunderstorm. The amount of precipitation produced by storm events determines the type of flooding. Flash floods, which typically occur more frequently than general floods, occur along small streams and creeks of the type that are present throughout Cabarrus County. The undermining or washing out of roads is typically associated with flash floods. General flooding occurs less frequently and as the result of much larger storm events such as hurricanes. These larger storm events occur along the East Coast of the United States most often in the late summer and fall.

(c) The total economic and loss of life impact depends greatly on the amount of development within the area. Currently, Cabarrus County has a moderate amount of development, mostly residential, along the floodplains of major streams and Rocky River. Both flash flooding and longer-term general flooding can cause massive damage and destruction to the structures located in these floodplains.

3. Tornadoes (Map A-1 Cabarrus County Multi-Hazards)

(a) Tornadoes, typically the by-product of a larger storm, are violently rotating columns of air that come in contact with the ground. Tornadoes are produced during severe thunderstorms, which are created near the junction between warm, moist air and cold, dry air. Tornadoes derive their energy from the heat contained in warm, moist air masses. Tornadoes do not form during every thunderstorm. They occur when the moist, warm air is trapped beneath a stable layer of cold dry air by an intervening layer of warm dry air. This is called an inversion. If this is disturbed, the moist air will push through the stable air that is holding it down. This warm air will then condense as the latent heat it holds is released. This air will then spiral upwards. With the help of different types of winds, this spiral gains speed, producing a tornado.

(b) Intensity. Tornadoes have a more localized impact than a hurricane. Tornadoes generally produce a narrow path of concentrated destruction from 0.01 mile wide to greater than 1 mile wide, but are generally less than .6 miles wide. Tornadoes may also produce paths of destruction from less than 1 mile in length to greater than 100 miles in length. The destruction caused by tornadoes may range from light to severe depending on the path of travel. Typically, structures of light construction, such as residential homes, suffer the greatest damage from tornadoes. A tornado will rarely last longer then 30 minutes. The combination of conditions that cause tornadoes are common across the southern U.S. in early spring, especially in April and May. Tornado intensity was originally measured using the Fujita-Pearson Scale. In February 2007, the Enhanced Fujita (EF) scale replaced the original Fujita scale in all tornado damage surveys in the United States.

Table A-2: Enhanced Fujita Tornado Intensity Scale

Category	Maximum Wind Speeds	Equivalent Saffir-Simpson Scale	Typical Effects
EF 0	65 - 85 mph.	NA	**Light damage**: Causes some damage to siding and shingles. (Hurricane wind speed begins at 73mph.)
EF 1	86 -110 mph.	Cat 1/2/3	**Moderate damage:** Considerable roof damage. Winds can uproot trees and overturn single- wide mobile homes. Flagpoles bend.
EF 2	111 - 135 mph.	Cat 3/4/5	**Considerable damage:** Most single-wide mobile homes destroyed. Permanent homes can shift off foundation. Flagpoles collapse. Softwood trees debarked
EF 3	136 - 165 mph	Cat 5	**Severe damage**: Hardwood trees debarked. All but small portions of houses destroyed
EF 4	166 - 200 mph	Cat 5	**Devastating damage:** Complete destruction of well-built residences, large sections of school buildings.
EF 5	Greater than 200 mph	NA	**Incredible damage**. Significant structural deformation of mid- and high-rise buildings.

4. Thunderstorms.

(a) Characteristics of Thunderstorms. Warm, humid conditions encourage thunderstorms as the warm, wet air updrafts into the storm. As warm, moisture rich air rises, it forms cumulus-nimbus clouds, thunderstorm clouds, usually with a flattened top or an anvil shape, reaching to 40,000 feet or more. If this air is unstable, the conditions are then there to cause hail, damaging winds and tornadoes. As a thunderstorm grows, electrical charges build up within the clouds. Oppositely charged particles exist at the ground level. The particles from both top and bottom then race towards each other to complete a circuit. Charge from the ground then surges upward at nearly one third the speed of light to produce lightning.

(b) Intensity of Storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 20 to 30 minutes. Any storm is potentially dangerous, especially if affects one locations for an extended period of time. The National Weather Service rates a thunderstorm as "severe" if it produces winds measured at 58 MPH or higher velocity; hail diameters of .75 inch or greater; or the storm or creates a tornado. Lightning is an additional threat during a thunderstorm and its intensity and location is largely unpredictable.

(c) Severe thunderstorms most frequently occur in the summer in Cabarrus County. These usually occur in the late afternoon or during the evening or night hours. Summer thunderstorms involve lightning, strong winds and heavy rains that can result localized wind damage, flash flooding and wildfires. The overall impact of

thunderstorms could be expected to be low due to the localized nature of the storms, but damage could be severe in those areas directly affected.

6. Severe Winter Storms

(a) Severe winter weather is typically associated with much colder climates; however, in some instances winter storms do occur in piedmont North Carolina. The impact of a winter storm in Cabarrus County can be paralyzing. Winter storms produce an accumulation of snow and ice on trees and utility lines resulting in loss of electricity and blocked transportation routes. Frequently, especially in rural areas, loss of electric power means loss of heat for residential customers, which poses an immediate threat to human life.

(b) The intensity of winter storms is measured by the temperature and the amount of precipitation accumulated. Wind velocity increases the danger from low temperatures by increasing the wind chill and causing the drifting of snow.

(c) Because of the rare occurrence of such an event, Cabarrus County and its municipalities are not completely equipped to handle the demands on public services caused by such events. The county does not provide road clearance in any portion of the county, as this is done by the NC Department of Transportation and the local municipalities. The priority is to clear the main highways and those areas needed for public safety. Municipalities clear streets within their town limits.

7. Wildfires

(a) Wildfires occur in North Carolina during the dry spring and summer months of the year. The potential for wildfires depends upon recent climate conditions, surface fuel characteristics, and fire behavior. Wildfires can destroy precious natural resources and forestry essential to the survival of wildlife.

(b) Intensity. There are three types of wildfires:

· Surface Fire – This type burns slowly along the floor of a forest. This is the most common type of wildland fire. This type of fire can damage or even kill trees.
· Ground Fire – Usually occurs from a lightning strike. This type of fire burns on or below the forest floor.
· Crown Fire – This fire is quickly spread by the wind. It tends to jump among the crowns of trees.

Wildland fires are generally characterized by very thick smoke. The spread of the fire depends on the weather, terrain, and forest conditions.

(c) Increased development in Cabarrus County in recent years has increased the potential impact of wildfires as structures that locate near vulnerable woodlands become vulnerable themselves. Because wind fuels wildfires, structures in close proximity to potential wildfire fuels are at risk of damage as wind direction and velocity change. According to data provided by the North Carolina Forest Service, the

frequency of wildfires in Cabarrus County is relatively moderate. Since 1992, there have been 601 wildfire incidents resulting in a total of 455 acres burned in Cabarrus County. Cabarrus County has 86,600 acres of forest land covering approximately 37% of the total land area. North Carolina Department of Environmental and Natural Resources Division of Air Quality enforces the state open burning regulations; Cabarrus County through its Fire Prevention Ordinance also enforces open burning regulations. However, residential build-up accesses to terrain are factors that can lead to negative effects from wildfires. The Division of Forest Resources has responsibility for protecting forest land from fires. This program is managed by a cooperative basis with Cabarrus County. Emphasis of the program includes fire prevention, suppression and enforcement.

Cabarrus County consists of rolling terrain in the Piedmont section of North Carolina. The concentration of Loblolly Pine Plantations is on the eastern and southern parts of the county which have more fire potential and higher values. The dominant timber type is still Oak- Hickory Fuel Type 55.6% followed by Loblolly – Shortleaf Pine 25.4%, Oak- Pine 10.8% and Oak- Gum at 8%.

Wildland Urban Interface is scattered throughout the county and continues to grow with new, foreclosing and current development in areas with significant slope combined with fuel types that are potential hazards during both spring and fall fire season. The current trend of close spacing in housing development further adds structures into the fuel mix.

The northwest corner of Cabarrus County has been heavily developed with little to no consideration for the Wildland Fire Hazards. This would be the area bounded by Iredell and Mecklenburg Counties, I -85, NC 3 and 29. The terrain can vary greatly from flat or rolling to deep steep gullies presenting control problems. The southern part of Cabarrus County bounded by NC 29, 601 and NC 200 Mecklenburg, Stanly and Union Counties has seen development recently and it has been rather large. This part of the county tends to have more extreme weather conditions concerning both wind and rain. Large blocks of woodlands still exist here. The eastern side bounded by I-85, NC 601 and 200 and Stanly and Rowan counties is rolling to fairly short steep slopes. This area is the least populated. The urban interface is more dealing with 1-5 structures and smaller subdivisions both new and older.

8. Earthquakes.

(a) An earthquake is a series of vibrations induced in the earth's crust by the abrupt rupture and rebound of rocks. It is caused by a slip on a fault, which is a thin zone of crushed rock between two blocks of rock. An earthquake occurs when stresses in the earth's outer layer push the sides of the fault together. Stress builds up and the rocks slips suddenly, releasing energy in waves that cause the shaking. Earthquakes can cause severe damage to property and extensive loss of life. Earthquakes can occur at any time of the day and are not related to weather patterns. An earthquake cannot be prevented, although mitigation measures can be taken, particularly structure measures, to reduce the impact that an earthquake has on the surface.

(b) Earthquakes are measured in terms of their magnitude and intensity. Magnitude is the measure of total energy released and intensity is the resulting degree of damage caused by an earthquake. Several techniques are used to measure these events. The Richter scale is a standard scale used to compare earthquakes. It is a logarithmic scale, meaning that the numbers on the scale measure factors of 10. An earthquake that measures 4.0 on the Richter scale is 10 times larger than one that measures 3.0. On the Richter scale, anything below 2.0 is undetectable to a normal person and is called a microquake. Microquakes occur constantly. Moderate earthquakes measure less than 6.0 on the Richter scale. Earthquakes measuring more than 6.0 can cause significant damage. The maximum quake rating ever measured is about 8.9. The Mercalli Scale is a subjective evaluation of the effects of an earthquake as evaluated by people in the area.

Table A-3: Earthquake Magnitude and Intensity Scales

RICHTER SCALE	MERCALLI SCALE	INTENSITY	DESCRIPTIONS OF EFFECTS
	I	Instrumental	Detected only by seismographs
Less than 4.2	II	Feeble	Noticed only by sensitive people.
	III	Slight	Resembling vibrations caused by heavy traffic.
	IV	Moderate	Felt by people walking; rocking of freestanding objects.
Less than 4.8	V	Slightly Strong	Sleepers awakened and church bells ring
Less than 5.4	VI	Strong	Trees sway, some damage from overturning and falling objects.
Less than 6.1	VII	Very Strong	General alarm, cracking of walls.
	VIII	Destructive	Chimneys fall and there is some damage to buildings.
Less than 6.9	IX	Ruinous	Ground begins to crack, houses begin to collapse and pipes break
Less than 7.3	X	Disastrous	Ground badly cracked and many buildings are destroyed. There are some landslides.
Less than 8.1	XI	Very Disastrous	Few buildings remain standing; bridges and railways destroyed; water, gas, electricity and telephones out of action.
	XII	Catastrophic	Total destruction; objects are thrown into the air, much heaving, shaking and distortion of the ground

(c) Earthquakes are relatively infrequent but not uncommon in North Carolina. From 1568 to 1992, 157 earthquakes have occurred in North Carolina. North Carolina's vulnerability to earthquakes decreases from west to east in relation to the Eastern Tennessee Seismic Zone. Cabarrus County lays on the far eastern edge of the most active region in the state. The USGS Seismic Hazard Maps indicate that the Cabarrus County region has an 8-10% probability of earthquake ground motion. Cabarrus

County has experienced very minor tremors on several occasions, but none could be rated as an earthquake.

9. Landslides. Landslides are the collapse of a mass of earth and rock down a steep slope or cliff. These often occur with other natural hazards such as earthquakes and floods. Landslides are not a serious risk in Cabarrus County due to the relatively low height of the hills in the county. Limited areas of steep slopes associated with the banks of major watercourses in the county could collapse under heavy rainfall to produce a localized landslide. The potential of damage to lives or property from this type of natural hazard is low within the county.

10. Soil Subsidence. Soil Subsidence is the sudden or gradual downward movement of the ground surface. This is a localized problem within the eastern area of the County. This area is the site of numerous abandoned sub-surface mines that date back to the gold-mining operations in Cabarrus County during the first half of the 19th Century. As the structures supporting the original mine shafts give way, these shafts collapse, occasionally causing "sink holes" to appear. As more development occurs in this area of the County, the likelihood of damage to structures from this hazard increases. However, no incidents of this type have occurred in the county between July 2004 and December 2009.

11. Drought and Extreme Summer Weather.

(a) A drought is defined as a condition of abnormally dry weather within a geographic region where some rain is usually expected. This is caused by a lack of precipitation in conjunction with wind, high temperatures, and low humidity. This lack of rain in a region results in a number of problems. There are varying degrees of severity in a drought. This severity depends on the demand on water in a region, duration, and intensity.

(b) There are four types of droughts:

(1) Meteorological Drought – This is a reduction of precipitation over time. This definition is regionally based. In the United States, this is indicated by less then 2.5mm of rainfall in 48 hours. This is the first indication of a drought.

(2) Agricultural Drought – This occurs when soil moisture cannot meet the demands of a crop. This type of drought happens after a meteorological drought but before a hydrological drought.

(3) Hydrological Drought – This type refers to reduction in surface and subsurface water supplies. It is measured through stream flow and water levels in lakes, reservoirs, and groundwater.

(4) Socioeconomic drought – This occurs when water shortages affect people, either in terms of water supply or economic impacts (i.e., loss of crops so price increases).

The intensity of a drought can be measured using the Palmer Drought Index.

Table A-4: Palmer Drought Index

CATEGORY	DESCRIPTION	POSSIBLE IMPACTS	PALMER DROUGHT INDEX	PERCENT OF NORMAL PRECIPITATION
D0	Abnormally Dry	Going into drought; short-term dryness slows planting, crop growth, and pastures; fire risk above average. Coming out of a drought; some lingering water deficits; pastures, crops not fully recovered	-1.0 to –1.9	Less than 75% for 3 months
D1	Moderate Drought	Some damage to crops, pastures, fire risk high, water sources at low level; some water shortages developing or imminent, voluntary water use restrictions requested	-2.0 to –2.9	Less than 70% for 3 months
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common, water restrictions imposed	-3.0 to –3.9	Less than 65% for 6 months
D3	Extreme Drought	Major crop/pasture losses; Extreme fire risk; widespread water shortages or restrictions.	-4.0 to –4.9	Less than 60% for 6 months
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams and wells, creating water emergencies	-5.0 or less	Less than 65% for 12 months

(c) Cabarrus County has experienced severe hot weather and periods of drought. Between January, 1950 and December 2009 the county and its municipalities recorded 20 drought events (see map A-1). These drought periods were particularly severe in 1948-50; 1966-67; 1986-87; 1997 and 2003-2008. Hot weather occurs from mid-July to late September. Periods of extreme summer weather intensify the effects of a drought, but do not cause it. While potentially dangerous to individuals, severe hot weather is not a serious hazard in the county. Drought conditions are mainly a hazard to farms and other agricultural operations. The decline in the level of the water table creates problems for those citizens who rely on wells for water, and the lack of rainfall also decreased the level of water in local reservoirs.

C. Natural Hazard Summary Assessment for Cabarrus County

1. North Carolina experiences different types of hazards with some more likely than others to impact different regions of the State. The North Carolina Division of Emergency Management has assessed the State's vulnerability to natural hazards by county. Table A-5 shows the State's summary assessment for Cabarrus County for the nine natural hazards identified as affecting North Carolina.

2. Natural Hazard Vulnerability of Cabarrus County.

Table A-5: Natural Hazard Summary Assessment for Cabarrus County

Natural Hazard	**NC EM Vulnerability Rating for Cabarrus County**	**Cabarrus County EM County Vulnerability Rating**
Hurricane	Low	Low
Flood	Moderate	Moderate
Tornado	High	High
Nor'easter	Low	Low
Thunderstorm	Moderate	High
Severe Winter Storm	Moderate	Moderate
Wildfire	Low	Low
Earthquake	Moderate	Low
Landslide	Moderate	Low
Drought	-	Low
Soil Subsidence	-	Low

Source: Local Hazard Mitigation Planning Manual, NCDEM, 1998, p. 81.

(a) The North Carolina Division of Emergency Management used the following methodology: Each of the one hundred counties in North Carolina was categorized into one of three levels of natural hazard probability – "Low", "Moderate", or "High" for eight natural hazards. Some assignments were made, in part, using the Climate Division to which each county was assigned. The Climate Division number for Cabarrus County is 5. (For additional information on how ratings were developed, see "Local Hazard Mitigation Planning Manual, North Carolina Division of Emergency Management, November 1998.) Thunderstorms were not rated in the Local Hazard Mitigation Planning Manual. For the purposes of this report, thunderstorms were rated moderate.

(b) The Cabarrus County Division of Emergency Management evaluated hazards using the state model, but adjusted it based on historical information on events in the county.

D. Potential Impact of Natural Hazards on Cabarrus County. The North Carolina Division of Emergency Management has estimated the potential impact of various natural hazards for Cabarrus County as shown in Table A-6.

Table A-6: Natural Hazards Potential Impact Data for Cabarrus County

Natural Hazard	Range	Cabarrus County
Earthquake Vulnerability	Low =1 to High = 6	3
Landslide Vulnerability	Low =1 to High = 6	3
Frequency of All Hurricanes, 1900-2009	Saffir-Simpson Class 1-5	0
Frequency of Minor Hurricanes, 1900-2009	Saffir-Simpson Class 1-2	0
Frequency of Major Hurricanes, 1900-2009	Saffir-Simpson Class 3-5	0
Nor'easter Vulnerability	1 = some direct vulnerability	0
Frequency of Tornadoes, 1953-2009	Number of tornadoes	11
Extreme 1-day snowfall	In inches	9
Drought	Low = 1, Mod. =2, High = 3	1
Wildfires, 1950-2009	Low = 1, Mod. =2, High = 3	1
Number of Acres Burned , 1950-2009	Low = 1, Mod. =2, High = 3	1
Soil Subsidence	Low = 1, Mod. =2, High = 3	1

Source: Local Hazard Mitigation Planning Manual, NCDEM, 1998, p. 86.

E. Hazard Index for Cabarrus County. Certain parts of the County, such as floodplains and steep river or creek banks, are more prone to hazards. In addition, certain types of hazards are likely to produce only localized effects while others have wide spread effects. Some natural hazards have extraordinary impacts but occur infrequently. Other hazards occur annually or several times a decade, but cause less damage. The total potential impact of each type of hazard can be projected using a combination of likely strength of the event, the size of the area(s) affected, and the density of human activity within the likely path of the hazard. Table A-7 gives each natural hazard a "hazard index" rating based on a combination of three factors – probability of occurrence, size of potential area affected, and the potential impact of the event. Assigned risk levels were based on historical and anecdotal data as well as input from planning committee members.

Table A-7: Hazard Index for Cabarrus County

Hazard Type	Probability of Occurrence	Potential Area Affected	Potential Impacts	Hazard Index (combined ranking)
Thunderstorm	Highly Likely	Medium	Negligible	1
Severe Winter Storm	Likely	Large	Limited	2
Tornado	Possible	Small	Limited	3
Flood	Likely	Small	Limited	4
Hurricane	Likely	Large	Limited	5
Wildfire	Likely	Small	Negligible	6
Drought	Possible	Large	Negligible	7
Earthquake	Unlikely	Large	Negligible	8
Landslide	Unlikely	Small	Negligible	9
Soil Subsidence	Unlikely	Small	Negligible	-
Nor'easter	Unlikely	-	-	-

Source: Keeping Natural Hazards from Becoming Natural Disasters, NCDEM, 1998, pp. 10-12.

F. History of Storm Events in Cabarrus County.

1. Thunderstorms, with accompanying high winds and lightning, are the most common of the natural hazards encountered in Cabarrus County. Since 1950, there are records for 134 major thunderstorms. Of these 134 storms, 7 produced lightning strikes causing some damage to property and 87 of these storms had winds that measured over 50 knots. Additionally, these thunderstorm events have produced flooding and occasionally tornadoes. During this same period there have been 93 reported hailstorms within the county.

2. Significant Weather Events since 1950. Tables A-8 through A-11 chronicle the history of major storm events in Cabarrus County. All information is from the National Climatic Data Center unless noted otherwise. This information is based on available records and there are gaps in this coverage.

Table A-8 Floods (25 Events)

Location	Date	Time	Type	Deaths	Injuries	Damages	
						Property	Crop
Countywide	06/18/92	0400	Flash Flood	0	1	2.0M	unk
Kannapolis	8/27/95	0300	Flash Flood	0	0	1.5 M	0
Countywide	10/04/95	1530	Flash Flood	0	0	0	0
Countywide	07/23/97	0140	Flash Flood	0	4	3.0M	2.0M
Southern Cabarrus	01/16/98	1630	Flood	0	0	0	0
Southern Cabarrus	04/09/98	0400	Flood	0	0	0	0
Mt Pleasant	09/29/99	1700	Flash Flood	0	0	0	0
Countywide	10/11/99	0500	Flood	0	0	0	0
Countywide	09/01/00	2300	Local Flooding	0	0	0	0
Countywide	03/15/03	0800	Local Flooding	0	0	0	0
Countywide	03/20/03	0900	Flood	0	0	1M	0
Countywide	04/10/03	0700	Flood	0	0	200k	0
Countywide	04/20/03	0430	Flood	0	0	0	0
Harrisburg/ Mt Pleasant	05/25/03	1800	Flash Flood	0	0	0	0
Harrisburg	06/07/03	2300	Flash Flood	0	0	0	0
Harrisburg	06/08/03	2200	Flash Flood	0	0	10k	0
Kannapolis	06/16/03	1730	Flash Flood	0	0	10k	0
Concord	06/16/03	1738	Flash Flood	0	0	0	0
Mt. Pleasant	06/16/03	2030	Flash Flood	0	0	10k	0
Concord	06/18/03	1515	Flash Flood	0	0	0	0
Harrisburg	06/14/04	1715	Flash Flood	0	0	0	0
Harrisburg	09/08/04	0530	Flash Flood	0	0	0	0
Countywide	09/28/04	0100	Flash Flood	0	0	700k	0
Midland	06/02/05	0815	Flash Flood	0	0	0	0
Rimer	06/07/05	1630	Flash Flood	0	0	0	0
Concord	06/09/05	1740	Flash Flood	0	0	0	0

Location	Date	Time	Type	Deaths	Injuries	Damages	
						Property	Crop
Kannapolis	07/04/05	0100	Flash Flood	0	0	0	0
Countywide	12/15/05	1700	Flood	0	0	0	0
Charlotte Motor Speedway	08/15/06	2015	Flash Flood	0	0	5k	0
Concord	08/30/06	1700	Flash Flood	0	0	0	0
Harrisburg/ Midland	11/22/06	0500	Flood	0	0	0	0
Concord	07/09/07	1900	Flash Flood	0	0	0	0
Concord	04/26/08	2000	Flash Flood	0	0	0	0
Concord	06/22/08	1915	Flash Flood	0	0	0	0
Kannapolis	08/27/08	0345	Flash Flood	0	0	1.0M	0
Harrisburg	08/27/08	0415	Flash Flood	0	0	5.5M	0
Kannapolis	08/27/08	0630	Flash Flood	0	0	1.0M	0
Jackson Park	06/05/09	1130	Flash Flood	0	0	0	0
Kannapolis	07/22/09	2115	Flash Flood	0	0	0	0
Concord	07/22/09	2200	Flash Flood	0	0	0	0
Midland	07/27/09	2145	Flash Flood	0	0	50k	0

Table A-9 Tornado (13 Events)

Location	Date	Time	Type	Deaths	Injuries	Damages	
						Property	Crop
Cabarrus	07/27/50	1620	F1	0	0	3k	0
Cabarrus	11/28/54	2230	F1	0	0	25K	0
Cabarrus	07/25/65	1530	F1	0	0	25K	0
Cabarrus	05/28/73	0500	F0	0	0	25K	0
Cabarrus	05/28/73	1800	F0	0	0	25K	0
Cabarrus	06/06/75	1800	F0	0	0	3K	0
Cabarrus	08/23/83	1710	F1	0	0	2.5M	0
Cabarrus	03/10/92	2155	F1	0	0	25K	0
Georgeville	09/29/99	1700	Funnel Cloud	0	0	0	0
Georgeville	09/29/99	1814	Funnel Cloud	0	0	0	0
Rimer	05/14/06	1349	F1	0	0	5K	0
West Concord	05/11/08	1719	F0	0	0	0	0
Watts Crossroads –Kluttz Rd	12/11/08	1550	F1	0	0	0	0

Table A-10 Snow/Ice Storms, Extreme Cold (31 Events)

Location	Date	Time	Type	Deaths	Injuries	Damages Property	Crop
Countywide	02/10/94	1000	Ice Storm	0	0	0	0
Countywide	01/06/96	1800	Winter Storm	0	0	0	0
Countywide	01/11/96	1800	Winter Storm	0	0	0	0
Countywide	02/02/96	0600	Ice Storm	0	0	10.0 M	0
Countywide	02/03/96	1800	Snow	0	0	0	0
Countywide	02/16/96	0200	Snow	0	0	0	0
Countywide	01/15/97	0200	Snow	0	0	0	0
Countywide	04/01/97	2400	Extreme Cold	0	0	0	0
Countywide	12/29/97	0530	Snow	0	0	0	0
Countywide	01/19/98	0600	Snow	0	0	0	0
Countywide	12/23/98	0900	Freezing Rain	0	0	0	0
Countywide	12/24/98	2400	Ice Storm	0	0	0	0
Countywide	02/19/99	1200	Snow	0	0	0	0
Countywide	03/09/99	0300	Snow/Sleet	0	0	0	0
Countywide	01/18/00	0400	Snow	0	0	0	0
Countywide	01/22/00	1500	Snow	0	0	0	0
Countywide	01/24/00	1300	Snow	0	0	0	0
Countywide	01/29/00	0100	Ice Storm	0	0	0	0
Countywide	11/19/00	0600	Snow	0	0	0	0
Countywide	12/01/00	2400	Extreme Cold	0	0	0	0
Countywide	12/04/02	2400	Ice Storm	0	0	2.0 M	0
Countywide	01/23/03	0600	Heavy Snow	0	0	0	0
Countywide	01/27/04	0001	Winter Mix	0	0	0	0
Countywide	02/26/04	1000	Heavy Snow	0	0	0	0
Countywide	12/15/05	0300	Winter Mix	0	0	0	0
Countywide	01/18/07	0600	Freezing Rain	0	0	0	0
Countywide	02/01/07	0800	Winter Mix	0	0	0	0
Countywide	01/16/08	2000	Winter Mix	0	0	0	0
Countywide	01/22/08	0700	Winter Mix	0	0	0	0
Countywide	01/20/09	0300	Heavy Snow	0	0	0	0
Countywide	02/03/09	2100	Winter Mix	0	0	0	0
Countywide	03/01/09	1400	Heavy Snow	0	0	0	0

Table A-11 Hurricanes and Tropical Storms (2 Events)

Location	Date	Time	Type	Deaths	Injuries	Damages Property	Crop
Countywide	09/21/89	2400	Hurricane Hugo	0	0	2.2 M	
Countywide	08/27/08	0100	Tropical Storm Fay	0	0	4.2 M	

Note: On 26-27 August 2008 Tropical Storm Fay stalled over Cabarrus County produced exceptionally heavy rains which caused heavy and widespread flooding throughout the county. This caused flooding in areas outside of the 500 year flood plain. Other hurricanes and tropical storms have passed through the county, but generally these were felt in the form of heavy rain and occasional localized flooding of roads. None of these other storms had a significant impact on the area.

3. Hazards Not Listed. Several hazards noted on the list developed by the state are not significant hazards in Cabarrus County. Landslides and Nor'Easters are not hazards to any measurable degree in Cabarrus County. No landslides have been recorded in Cabarrus County. The county is far enough inland in the state that the hazard from a Nor'Easter is nothing more than normal winter rainfall.

G. Technological Hazards

1. Hazardous Materials.

(a) Any area that manufactures hazardous materials, or contains transportation routes (roads, rail) that transports hazardous materials is at risk for a hazardous material event. Approximately 6,774 hazardous materials (HazMat) events occur each year. 991 are railway events. Trucks are responsible for most of the remainder of events. The Federal Motor Carrier Safety Administration has determined that the average frequency of hazardous materials accidents for one year was estimated to be 2,484 accidents, with 768 resulting in the release of hazardous materials. The average annual frequency of hazardous materials incidents was 1,455. The average annual frequency for loading/unloading incidents was 10,746. The average distance for trip lengths for gasoline transport is 28 miles the average trip length for chemical trucks is 260 miles. Even though trucks account for most accidents, it is railway transport that is of most concern. Collisions and derailments can cause very large spills as it is rare that a single car will go over. An average of 280 HazMat spills occur at fixed sites each year. Natural disasters, such as floods and earthquakes can cause HazMat releases or disturb old HazMat release sites (Superfund sites). These same disasters can make it difficult to contain these events once they occur. Also, natural disasters can limit access to the spill, waterlines for fire suppression may be broken, and response personnel and resources may be limited. Flooding and high winds can quickly spread the contaminant, threatening agriculture, the water supply and air. HazMat releases pose short and long term threats to people, wildlife, vegetation, and the environment. HazMat materials can be absorbed through inhalation, ingestion, or direct contact with the skin.

(b) In previous years, wastes were dumped on the ground, in rivers, or left out in the open. As a result, thousands of uncontrolled or abandoned waste sites were created. Some common hazardous waste sites include abandoned warehouses, manufacturing facilities, processing plants and landfills. In response to growing concern over health and environmental risks posed by hazardous waste sites, Congress established the Superfund Program in 1980 to clean up these sites. The Superfund Program is

administered by the U.S. Environmental Protection Agency (EPA) in cooperation with individual sites throughout the United States. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) is the official repository for site and non-site specific Superfund data in support of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). It contains information on hazardous waste site assessment and remediation from 1983 to the present.

(c) North Carolina maintains its own list of hazardous waste sites. The North Carolina Inactive Hazardous Sites Response Act of 1987 (N.C.G.S. 130A-310 et seq) was enacted to establish a program to manage uncontrolled and unregulated hazardous wastes sites administered by the Inactive Hazardous Sites Branch (IHSB). The IHSB can address any site where hazardous substance and/or hazardous waste contamination exists with the following exceptions: (1) RCRA permitted or interim status facilities; and (2) any site where the Environmental Management Commission, the Commissioner of Agriculture or the Pesticide Board has assumed jurisdiction. IHSB has the authority to do the following:

- Provide leadership and approval in voluntary remedial actions.
- Enforce assessment and remediation orders at priority sites.
- Reducing public health threats.
- Administering the Registered Environmental Consultant (REC) Program.
- Record notices of contamination on property deeds.
- Compile, maintain and prioritize sites that require investigation.

Just because a hazardous waste site is not listed on the CERCLIS that does not mean that it has been removed from the NC Inactive Hazardous Site list as well.

(d) Additional Hazardous Waste data is contained in the Resources Conservation and Recovery Information System (RCRIS) in support of the Resource Conservation and Recovery Act (RCRA). RCRA requires that businesses or individuals that generate, transport, treat, store, and dispose of hazardous waste provide information concerning their activities to state environmental agencies. These agencies then provide the information to regional and national U.S. Environmental Protection Agency (EPA) offices. RCRIS is used by the EPA to support its implementation of RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA). The system is primarily used to track handler permit or closure status, compliant with Federal and State regulations, and cleanup activities. Other uses of the data include program management, regulation development, waste handler inventory, corrective action tracking, regulation enforcement, facility management planning, and environmental program progress assessment.

(e) Hazard Vulnerability.

(1) There are approximately 29.76 miles of railroad in Cabarrus County, mostly used by the Norfolk Southern Railroad for cargo traffic, which includes hazardous substances.

(2) There are 87 facilities within Cabarrus County that are required to report quantities of chemical substances that the EPA has determined are hazardous. Of these facilities, 13 store or handle compounds that the EPA designates Extremely Hazardous Substances (EHS). These facilities employ one or more of thirteen individual Extremely Hazardous Substances. The most common EHS in the county are anhydrous ammonia., used in commercial coolant systems, and sulfuric acid, generally found in batteries.

(f) Hazard Mitigation.

(1) Current zoning ordinances and construction codes control the location and type of facilities that employ hazardous materials. Older facilities in the county, such as textile mills, are located closer to populated areas than the newer construction, which could cause problems in these areas. All of these facilities must meet storage requirements as established by the EPA.

(2) The county and municipalities are improving response capabilities within their public safety agencies. The Concord Fire Department has developed a hazardous response team, similar to the regional response teams organized by the State of North Carolina. Additionally, the county and municipalities have organized a Special Hazards Response Team to react to a variety of hazardous materials incidents.

2. McGuire Nuclear Power Station

(a) This facility is located at the southern end of Lake Norman in Mecklenburg County. Cabarrus County falls within the Emergency Planning Zone (EPZ) of the McGuire facility. This area has a radius of about 50 miles around the nuclear facility and is divided into two zones. The first zone is a 10-mile Plume Exposure Pathway, in which the bulk of exposure to radiation or ingestion of radiological contaminants would occur. The county lies just outside the eastern side of this zone. The other zone, which includes the 10-mile EPZ, is a 50-mile Ingestion Exposure EPZ. The 50-mile EPZ is based on a number of considerations. One of those is that the downwind range, potentially threatened by contamination, would generally be limited to about 50-miles or less from the power plant because of wind shifts, wind speed during the release, and radioactive decay. Another is that the particulate material from a radioactive plume would have been deposited on the ground within 50 miles of the facility.

(b) Hazard Vulnerability. The US Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) require safety analysis for nuclear facilities. The United States requires extensive reviews of design and safety to ensure the safety of workers and the public. Even if an accident were to occur within the plant, regulators require that facilities be designed to withstand the damage, and thus eliminating secondary effects on the public. Therefore, due to the extensive regulations and safety measures, there is a very limited chance of a nuclear plant accident that would seriously affect Cabarrus County.

(c) Hazard Mitigation.

(1) The County Emergency Management Department participates in scheduled drills with Duke Power and NCEM to practice response activities to an incident at the McGuire facility. Cabarrus County is considered a "host" county and is prepared to receive evacuees from northeastern Mecklenburg County. Plans exist to control traffic, conduct radiological monitoring and establish shelters for any evacuees.

(2) There have been no incidents at McGuire Nuclear Power Plant that have affected Cabarrus County. Residents of Cabarrus County would be required to shelter in place during a release of a radiological hazard, if the conditions indicate that the contaminant plume (cloud) would pass over an area of the county. Limited evacuation of selected households is possible, but not considered likely to be needed, based on the evaluation of possible incidents by both Duke Power and the North Carolina Division of Emergency Management (NCEM).

R. Additional County Mitigation Strategies.

(a) As a result of the terrorist attacks in 2001, the emergency response agencies from all municipalities and county government formed an Emergency Response Group to meet and coordinate planning and training for a response to a terrorist attack. This group has directed the purchase of additional equipment and supplies to conduct this mission. The city of Concord has developed a Hazardous Material team within its fire department and is developing a structural collapse team. Additionally, the county and municipal agencies have created a Special Hazards Response Team from available assets to react to a variety of threats.

(b) The increased awareness, training, and additional equipment to respond to a possible terrorist incident is also available for use in an emergency caused by a natural hazard. The closer degree of cooperation and communication developed by this effort will produce a quicker and more effective response to any emergency situation.

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